UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 22, 2016

Mr. Scott Batson
Site Vice President
Oconee Nuclear Station
Duke Energy Carolinas, LLC
7800 Rochester Highway
Seneca, SC 29672-0752

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 – RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (RELIEF REQUEST NOS. 15-ON-002 AND 15-ON-003, FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL) (CAC NOS. MF6506, MF6507, AND MF6511)

Dear Mr. Batson:

In two letters dated July 15, 2015 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML15202A032 and Accession No. ML15202A052), Duke Energy Carolinas, LLC (the licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) Request for Relief (RR) Nos. 15-ON-002 and 15-ON-003 from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, for the Oconee Nuclear Station, Units 1, 2, and 3 (ONS 1, 2, and 3). The licensee requested relief from examination coverage requirements in ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." These requests apply to the fourth 10-year inservice inspection (ISI) interval in which ONS 1, 2, and 3 adopted the 1998 Edition through the 2000 Addenda of ASME Code Section XI as the code of record. Additionally, in response to an NRC Request for Additional Information, the licensee submitted further information in a letter dated June 1, 2016 (ADAMS Accession No. ML16155A079).

Specifically, pursuant to Title 10 of the Code of Federal Regulations (10 CFR) 50.55a(g)(6)(i), the licensee requested relief from the required examination coverage for inspection of certain component welds on the basis that the ASME Code requirements are impractical. The NRC staff has reviewed the licensee's submittals and concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR Nos. 15-ON-002 and 15-ON-003. Furthermore, based on the volumetric examination coverage obtained, it is reasonable to conclude that if significant service-induced degradation was present, evidence of it would have been detected by the examinations that were performed. Therefore, for the items in the licensee's requests, relief is granted, pursuant to 10 CFR 50.55a(g)(6)(i), for the subject welds during the fourth ISI interval at ONS 1, 2, and 3.

All other ASME Code requirements for which relief was not specifically requested and approved in this RR remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Senior Project Manager, Mr. James R. Hall, at Randy.Hall@nrc.gov or 301-415-4032.

Sincerely,

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING RELIEF REQUEST NOS. 15-ON-002 AND 15-ON-003

FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL

DUKE ENERGY CAROLINAS, LLC

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-269, 50-270, AND 50-287

1.0 INTRODUCTION

In two letters dated July 15, 2015 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML15202A032 and Accession No. ML15202A052), Duke Energy Carolinas, LLC (Duke Energy, the licensee), submitted Request for Relief (RR) Nos. 15-ON-002 and 15-ON-003 from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, for the Oconee Nuclear Station, Units 1, 2, and 3 (ONS 1, 2, and 3). The licensee requested relief from examination coverage requirements in ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." These requests apply to the fourth 10-year inservice inspection (ISI) interval in which ONS 1, 2, and 3 adopted the 1998 Edition through the 2000 Addenda of ASME Code Section XI as the code of record. Additionally, in response to a U.S. Nuclear Regulatory Commission (NRC or the Commission) Request for Additional Information (RAI), the licensee submitted further information in a letter dated June 1, 2016 (ADAMS Accession No. ML16155A079). RR No. 15-ON-002 addresses certain component welds in ONS 1 and 2; RR No. 15-ON-003 addresses certain component welds in ONS 3.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief from the required examination coverage for ISI of the subject welds on the basis that the Code requirements are impractical. The NRC staff has evaluated both of the subject RRs, as discussed in Section 3.0 of this safety evaluation.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in ASME Code Section XI to the extent practical, within the limitations of design, geometry, and materials of construction of the components.

Pursuant to 10 CFR 50.55a(g)(4)(ii), inservice examination of components during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in paragraph (a) of 50.55a 12 months before the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," when using Section XI, which is incorporated by reference in paragraph (a)(3)(ii) of 50.55a), subject to the conditions listed in paragraph (b) of 10 CFR 50.55a.

The regulation in 10 CFR 50.55a(g)(5)(iii) states, in part, that a licensee may determine that conformance with certain ASME Code requirements is impractical and that the licensee shall notify the Commission and submit information in support of the determination. Determination of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the ISI interval for which the requests are being submitted. RRs made in accordance with this section must be submitted to the NRC no later than 12 months after the expiration of the initial 120-month inspection interval or subsequent 120-month inspection interval for which relief is sought.

The regulation in 10 CFR 50.55a(g)(6)(i) states that the Commission will evaluate determinations under paragraph (g)(5) of this section that Code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The licensee has requested relief from ASME Code requirements pursuant to 10 CFR 50.55a(g)(5)(iii). The ASME Code of record for the ONS 1, 2, and 3, fourth 10-year ISI program, which ended on July 15, 2014, is the 1998 Edition, including the 2000 Addenda, of Section XI of the ASME Code.

3.0 TECHNICAL EVALUATION

The information provided by Duke Energy in support of the RRs from ASME Code requirements has been evaluated, and the bases for disposition are documented below. For clarity, the requests have been evaluated in several parts according to ASME Code Examination Category.

3.1 RR Nos. 15-ON-002 and 15-ON-003, Part A, Examination Category B-A, Items B1.11 and B1.21, Pressure Retaining Welds in Reactor Vessels, ONS 1, 2, and 3

ASME Code Requirement: Table IWB-2500-1, Examination Category B-A, Items B1.11 and B1.21, require essentially 100 percent volumetric examination, as defined by Figures IWB-2500-1 and IWB-2500-3, of the length of reactor pressure vessel (RPV) circumferential shell welds and the accessible length of RPV circumferential head welds. "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 17.

Licensee's ASME Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination for the RPV circumferential shell and head welds listed below in Tables 3.1.1 (ONS 1), 3.1.2 (ONS 2), and 3.1.3 (ONS 3).

Table 3.1.1 - Examination Category B-A (Unit 1)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B1.11	1-RPV-WR34	Reactor Vessel Lower Shell Course-to-Lower Ring Section Weld	43.0%
B1.21	1-RPV-WR35	Reactor Vessel Lower Head Cap Section-to-Lower Head Ring Section Weld	36.0%

Table 3.1.2 - Examination Category B-A (Unit 2)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B1.11	2-RPV-WR18	RPV Upper Nozzle Belt-to-Upper Shell Weld	78.6%
B1.11	2-RPV-WR34	RPV Lower Shell to-Transition Piece Weld	42.7%
B1.21	2-RPV-WR35	RPV Transition Piece-to-Lower Head Weld	36.4%

Table 3.1.3 - Examination Category B-A (Unit 3)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B1.11	3-RPV-WR18	RPV Upper Nozzle Belt-to-Upper Shell Weld	79.0%
B1.11	3-RPV-WR34	RPV Lower Shell to-Transition Piece Weld	42.7%
B1.21	3-RPV-WR35	RPV Transition Piece-to-Lower Head Weld	36.4%

Licensee's Basis for Relief Request: (as stated)

RPV Upper Nozzle Belt-to-Upper Shell Weld (ONS 2 and 3)

The impracticality was caused by the Reactor Vessel Outlet Nozzle Boss configuration that does not allow meaningful interrogation. The current configuration does not allow scanning of all of the required volume for this weld. The weld configuration would have to be redesigned and replaced, which is impractical.

RPV Lower Shell Course-to-Lower Ring Section Weld and RPV Lower Shell-to-Transition Piece Weld (ONS 1, 2, and 3)

The impracticality was caused by the Reactor Vessel Interior configuration (Core Guide Lugs and Flow stabilizers) that does not allow meaningful interrogation. The current configuration does not allow scanning of all of the required volume for this weld. The weld configuration would have to be redesigned and replaced, which is impractical.

RPV Lower Head Cap Section-to-Lower Head Ring Section Weld and RPV Transition Piece-to-Lower Head Weld (ONS 1, 2, and 3)

The impracticality was caused by the Reactor Vessel interior configuration (Incore Nozzles and Flow Stabilizers) that does not allow meaningful interrogation. The current configuration does not allow scanning of all of the required volume for this weld. The weld configuration would have to be redesigned and replaced, which is impractical.

Licensee's Proposed Alternative Examination:

For these welds, the licensee reported the percentage of the examination coverage achieved by the ultrasonic testing (UT) in the examination performed.

The licensee proposed this alternative coverage (i.e., coverage achieved) for the volumetric examination of each weld in lieu of the ASME Code required essentially 100 percent coverage.

NRC Staff Evaluation:

The ASME Code requires essentially 100 percent volumetric examination of pressure retaining welds in the RPV. However, for the subject welds at ONS 1, 2, and 3, complete examinations are restricted by their design geometry and the proximity of surrounding appurtenances. In order to effectively increase the examination coverage, the RPV weld configurations and adjacent components would require design modifications or replacement. This would place a burden on the licensee; thus, examining essentially 100 percent of the ASME Code-required volumes is considered impractical.

The designs of the ONS 1, 2, and 3 RPVs limit the examination of the subject welds as shown in sketches and technical descriptions provided by the licensee. The RPV circumferential shell and head welds listed in Tables 3.1.1, 3.1.2, and 3.1.3 were examined using 45-degree shear and 45- and 70-degree refracted longitudinal wave scans with procedures, personnel, and equipment that have successfully passed the performance demonstration requirements outlined in ASME Code Section XI, Appendix VIII. Examinations of the circumferential shell and head welds were performed with automated ultrasonic inspection equipment from the inside surface of the RPV. For the subject Upper Nozzle Belt-to-Upper Shell Welds at ONS 2 and 3, ultrasonic examinations were restricted due to the configuration of the outlet nozzle boss. The licensee was able to obtain approximately 79.0 percent of the required ASME Code volume. Ultrasonic examinations for the subject Lower Shell Course-to-Lower Ring Section Welds and Lower Shell-to-Transition Piece Welds (ONS 1, 2, and 3) were restricted due to proximity of the guide lugs and flow stabilizers on the interior of the RPV. The licensee was able to obtain approximately 43.0 percent of the required ASME Code volume.

Ultrasonic examinations for the Lower Head Cap Section-to-Lower Head Ring Section Weld (ONS 1) and Transition Piece-to-Lower Head Welds (ONS 2 and 3) were restricted due to proximity of the incore nozzles, core guide lugs, and flow stabilizers on the interior of the RPV. The licensee stated that approximately 36 percent of the required ASME

Code volume was obtained for these three welds. ASME Code, Section XI, Item B1.21, requires that RPV circumferential head welds be subject to essentially 100 percent volumetric examination of only the "accessible length" of these welds. Based on the licensee's initial submittal and subsequent clarification in the response to the staff's RAI, it has been determined that the 36 percent value for the Item B1.21 welds was calculated based on the entire length of the weld, but that the volume covered by the examination corresponds to only a portion of the accessible length of the full weld. The full weld length is stated to be approximately 449 inches, while only approximately 206 inches of this length is accessible due to the stated RPV appurtenances. Of the 206 inches of the weld that is stated to be accessible, only about 161 inches were volumetrically examined at 100 percent coverage, and approximately 45 inches of accessible weld were volumetrically examined at less than 100 percent coverage. An example of the licensee's coverage calculations (as stated) is shown below in italics:

> *The aggregate coverage that was obtained is described and calculated from the following:*
>
> - *Inner 15% thickness (T) coverage using 45° & 70° longitudinal waves for axial scans (S1, S2), and circumferential scans (CW, CCW) obtained 33.00% coverage.*
> - *Outer 85% thickness (T) coverage using 45° longitudinal waves and 45° shear waves for axial scans (S1, S2), and circumferential scans (CW, CCW) obtained 37.00% coverage.*
> - *The aggregate coverage was calculated to be (15%)(33%) + (85%)(37%) = 36.00%.*

For all eight Examination Category B-A welds described in Tables 3.1.1, 3.1.2, and 3.1.3, over eighty indications were observed and were evaluated and determined to be acceptable per ASME Code Section XI, IWB-3510-1.

The licensee has shown that it is impractical to meet the ASME Code-required essentially 100 percent volumetric examination coverage for RPV circumferential shell and head welds at ONS 1, 2, and 3 due to their design geometries and proximity of integral RPV appurtenances. Based on the volumetric coverage obtained, along with the examination of other RPV pressure retaining welds, it is reasonable to conclude that if significant service-induced degradation was present, evidence of it would have been detected by the examinations that were performed. Therefore, the NRC staff concludes that the coverage achieved is acceptable.

3.2 RR Nos. 15-ON-002 and 15-ON-003, Part B, Examination Category B-B, Item 2.51, Pressure Retaining Welds in Vessels Other than Reactor Vessels, ONS 1 and 3

ASME Code Requirement: Table IWB-2500-1, Examination Category B-B, Item B2.51, requires essentially 100 percent volumetric examination, as defined by Figures IWB-2500-1 and IWB-2500-3, of the length of heat exchanger (primary side) circumferential head welds. "Essentially 100 percent," as clarified by ASME Code Case N-460, is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 17.

Licensee's ASME Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination for Letdown Cooler Inlet and Outlet Channel Body-to-Chemical Connector Welds listed below in Tables 3.2.1 (ONS 1) and 3.2.2 (ONS 3).

Table 3.2.1 - Examination Category B-B (Unit 1)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B2.51	1LDCB-INLET (WJ-32)	Letdown Cooler Inlet Channel Body-to-Chemical Connector Welds	87.7%
B2.51	1LDCB-OUTLET	Letdown Cooler Outlet Channel Body-to-Chemical Connector Welds	87.7%

Table 3.2.2 - Examination Category B-B (Unit 3)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B2.51	3-LDCA-IN-1	Letdown Cooler 3A, Chemical Connector-to-Channel Body Weld	87.7%
B2.51	3-LDCA-OUT-WJ35V	Letdown Cooler 3A, Chemical Connector-to-Channel Body Weld	87.7%

Licensee's Basis for Relief Request: (as stated)

The impracticality was caused by the weld taper configuration and nozzle on the chemical connector that does not allow meaningful interrogation. In order to scan all of the required volume for this weld, the chemical connector and location of the adjacent nozzle would have to be redesigned and replaced, which is impractical.

Licensee's Proposed Alternative Examination:

For these welds, the licensee reported the percentage of the examination coverage achieved by the UT in the examination performed.

The licensee proposed this alternative coverage (i.e., coverage achieved) for the volumetric examination of each weld in lieu of the ASME Code required essentially 100 percent coverage.

NRC Staff Evaluation:

The ASME Code requires essentially 100 percent volumetric examination of Class 1 heat exchanger circumferential head welds. However, for the subject welds at ONS 1 and ONS 3, complete ultrasonic testing examinations are restricted by weld geometric configuration and scan limitations caused by adjacent appurtenances. In order to effectively increase the examination coverage, the heat exchanger and nearby nozzle would require design modifications or replacement. This would place a burden on the licensee; thus, examining 100 percent of the ASME Code-required volume is considered impractical.

As shown in the sketches and technical descriptions included in the licensee's submittals, examination of the Letdown Cooler inlet and outlet channel body-to-chemical connector welds have been performed to the extent practical, with the licensee obtaining approximately 87.7 percent coverage of the ASME Code-required inspection volume. The taper configuration of the chemical connector to the channel body and the close proximity of a nozzle on the channel body side limited the ASME Code-required volumetric examination for the stainless steel Letdown Cooler circumferential head welds. These welds were examined with ultrasonic techniques using 45-degree shear and 45-, 60-, and 70-degree longitudinal waves in accordance with applicable requirements of the ASME Code Section XI, Appendix III. Seven indications were observed on the subject welds, four indications on 1LDCB-Inlet (ONS 1), and 3 indications on 1LDCB-Outlet (ONS 1). All indications were evaluated and determined to be non-relevant reflections from geometric sources (i.e., from the weld root and inside diameter (ID) surface offset).

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject heat exchanger circumferential head welds due to the design geometry of the Letdown Cooler and adjacent nozzle. Based on the ultrasonic results and the significant volumetric coverage obtained, it is reasonable to conclude if significant service-induced degradation was present, evidence of it would have been detected by the examinations that were performed. Therefore, the NRC staff concludes that the coverage achieved is acceptable.

3.3 RR Nos. 15-ON-002 and 15-ON-003, Part C, Examination Category B-D, Items B3.110 and B3.150, Full Penetration Welded Nozzles in Vessels, ONS 2 and 3

ASME Code Requirement: Table IWB-2500-1, Examination Category B-D, Items B3.110 and B3.150 require 100 percent volumetric examination, as defined by Figures IWB-2500-7 (a) through (d), as applicable, of full penetration Class 1 pressurizer (PZR) and heat exchanger (primary side) nozzle-to-vessel welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 17, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable, provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

Licensee's ASME Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations for the PZR and Letdown Cooler nozzle-to-vessel welds listed below in Tables 3.3.1 (ONS 2) and 3.3.2 (ONS 3).

Table 3.3.1 - Examination Category B-D (Unit 2)

Code Item	Weld ID	Weld Type	Coverage Obtained
B3.110	2-PZR-WP-26-1	Pressurizer Shell-to-Sampling Nozzle Weld	30.2%
B3.110	2-PZR-WP26-2	Pressurizer Shell-to-Sampling Nozzle Weld	30.2%
B3.110	2-PZR-WP26-3	Pressurizer Shell-to-Sampling Nozzle Weld	34.7%
B3.150	2-LDCB-IN-WJ33V	Letdown Cooler 2B Nozzle-to-Channel Body Weld	54.8%

Table 3.3.1 - Examination Category B-D (Unit 2)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B3.150	2-LDCB-OUT-WJ36V	Letdown Cooler 2B Nozzle-to-Channel Body Weld	54.8%

Table 3.3.2 - Examination Category B-D (Unit 3)			
Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained**
B3.150	3-LDCB-IN-WJ33V	Letdown Cooler 3B Nozzle-to-Channel Body Weld	60.6%
B3.150	3-LDCB-OUT-WJ36V	Letdown Cooler 3B Nozzle-to-Channel Body Weld	60.6%

Licensee's Basis for Relief Request: (as stated)

PZR Nozzle-to-Vessel Welds (ONS 2) - The impracticality was caused by the weld taper configuration of the sampling nozzle to the shell that does not allow meaningful interrogation from Surface 2, the sampling nozzle side. In order to scan all of the required volume for this weld, the shell-to-sampling nozzle weld would have to be redesigned or replaced to allow scanning from both sides of the weld, which is impractical.

Letdown Cooler Nozzle-to-Vessel Welds (ONS 2 and 3) - The impracticality was caused by the weld taper configuration of the nozzle-to-channel body that does not allow meaningful interrogation from Surface 2, the nozzle side. In order to scan all of the required volume for this weld, the channel body-to-nozzle weld would have to be redesigned and replaced to allow scanning from both sides of the weld, which is impractical.

Licensee's Proposed Alternative Examination:

For these welds, the licensee reported the percentage of the examination coverage achieved by the UT in the examination performed.

The licensee proposed this alternative coverage (i.e., coverage achieved) for the volumetric examination of each weld in lieu of the ASME Code required essentially 100 percent coverage.

NRC Staff Evaluation:

The ASME Code requires 100 percent volumetric examination of Class 1 nozzle-to-vessel welds. However, the design configuration of the subject welds and curvature of the nozzles' blend radii limit access for ultrasonic scanning. In order to effectively increase the examination coverage, the nozzle-to-vessel welds would require design modifications. This would place a burden on the licensee; thus, obtaining 100 percent of ASME Code-required volumetric examinations is considered impractical.

The subject PZR nozzle-to-vessel welds in ONS 2 (Table 3.3.1) are constructed of carbon steel material with stainless steel inside diameter surface cladding. The Letdown Cooler nozzle-to-vessel welds in ONS 2 (Table 3.3.1) and ONS 3 (Table 3.3.2) are constructed of wrought stainless steel material. These full penetration butt welds extend the full thickness of the vessel head, and the nozzle configurations are of the "set-in" design, which essentially make the welds concentric rings aligned parallel with the nozzle axes in the through-wall direction of the vessel. This nozzle design geometry restricts ultrasonic scanning mainly to the vessel side of the welds. In addition, ultrasonic scans cannot be performed from the curved outside diameter surface in the nozzle blend radius regions, further limiting the volumetric examinations.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject PZR and Letdown Cooler nozzle-to-vessel welds have been completed to the extent practical with volumetric coverage ranging from approximately 30.2 to 60.6 percent (see Tables 3.3.1 and 3.3.2) of the ASME Code-required volumes. The examination volumes included the weld and base materials near the inside surface of the weld joint, which are high regions of stress and where one would expect degradation sources to be manifested should they occur. The PZR and Letdown Cooler nozzle-to-vessel weld examinations were performed with manual ultrasonic techniques in accordance with the applicable requirements of the ASME Code Section V, Article 4, and ASME Code Section XI, Appendix III, respectively. The welds were examined using 0-degree longitudinal, 45-, 60-, and 70-degree shear, and 45-, 60-, and 70-degree longitudinal waves (L-waves), as applicable. There were no indications detected on the subject nozzles.

Although ultrasonic scans were primarily limited to the vessel side, studies have found that inspections conducted through carbon steel are equally effective, whether the ultrasonic waves have only to propagate through the base metal or have to also propagate through the carbon steel weldment.[1] Therefore, it is expected that the ultrasonic techniques employed by the licensee on the PZR nozzle-to-vessel welds would detect structurally significant flaws that might occur on either side of the subject welds due to the fine-grained carbon steel microstructures present in these materials.

Additionally, L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds.[2,3,4] While the licensee has only taken credit for limited

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[1] Heasler, P. G. and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475, U.S. Nuclear Regulatory Commission, Washington, DC.

[2] Ammirato, F. V., X. Edelmann, and S. M. Walker, *Examination of Dissimilar Metal Welds in BWR Nozzle-to-Safe End Joints*, 8th International Conference on NDE in the Nuclear Industry, ASM International, 1987.

[3] Lemaitre, P., T. D. Koble, and S. R. Doctor, *PISC III Capability Study on Wrought-to-Wrought Austenitic Steel Welds: Evaluation at the Level of Procedures and Techniques*, Effectiveness of Nondestructive Examination Systems and Performance Demonstration, PVP-Volume 317, NDE-Volume 14, ASME, 1995.

[4] Anderson, M. T., A. A. Diaz, A. D. Cinson, S. L. Crawford, S. E. Cumblidge, S. R. Doctor, K. M. Denslow, and S. Ahmed, 2011. *An Assessment of Ultrasonic Techniques for Far-Side Examinations of Austenitic Stainless Steel Piping Welds*, NUREG/CR-7113, PNNL-19353, U.S. Nuclear Regulatory Commission, Washington, DC.

volumetric coverage obtained from primarily one side, it is expected that the techniques employed would have provided coverage beyond the near-side of the Letdown Cooler nozzle-to-vessel welds.

The licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject nozzle-to-vessel welds due to the nozzles' design and curvature of the nozzles' blend radii. Based on the volumetric coverage obtained for the subject welds, and considering the licensee's performance of ultrasonic techniques employed to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation was present, evidence of it would have been detected by the examinations that were performed. Therefore, the NRC staff concludes that the coverage achieved is acceptable.

3.4 RR No. 15-ON-002, Part D, Examination Category B-J, Item B9.11, Pressure Retaining Welds in Piping, ONS 1

ASME Code Requirement: Table IWB-2500-1, Examination Category B-J, Item B9.11, requires essentially 100 percent volumetric and surface examinations, as defined by Figure IWB-2500-8, for circumferential piping welds NPS 4 or larger. "Essentially 100 percent," as clarified by ASME Code Case N-460, is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 17.

Licensee's ASME Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination of Class 1 Reactor Coolant Pump (RCP) 1A1 Nozzle-to-Safe End piping Weld 1-PDA1-1 (ONS 1).

Licensee's Basis for Relief Request: (as stated)

RCP Nozzle-to-Safe End Weld (ONS 1) - The impracticality was caused by the cast stainless material that does not allow meaningful interrogation from the Surface 2 RCP-1A1 side. The current configuration allows 100 percent scanning of all of the required volume for this weld, but credit for the surface 2 cast stainless side, which is considered "best effort," is not being claimed. The weld configuration would have to be redesigned and replaced, which is impractical.

Licensee's Proposed Alternative Examination:

For this weld, the licensee reported the percentage of the examination coverage achieved by the ultrasonic testing (UT) in the examination performed.

The licensee proposed this alternative coverage (i.e., achieved coverage) for the volumetric examination of this weld in lieu of the ASME Code required essentially 100 percent coverage.

NRC Staff Evaluation:

The ASME Code requires essentially 100 percent volumetric and surface examinations for selected Examination Category B-J pressure retaining welds in piping. However, complete volumetric examinations are restricted by materials and weld configuration. These conditions preclude the licensee from obtaining full volumetric examinations from both sides of this weld. To gain access for examination, the weld would require design modifications. Imposition of this requirement would create a burden on the licensee; therefore, the ASME Code-required volumetric examinations are considered impractical.

As shown on the sketches and technical description included in the licensee's submittal, examinations of the subject RCP1A1 nozzle-to-safe end piping Weld 1-PDA1-1 have been completed to the extent practical with the licensee, claiming 50 percent coverage of the ASME Code-required volume. The limitations encountered during the performance of the ultrasonic examinations were caused by cast austenitic stainless steel material and curvature of the taper of the transition region from the nozzle-to-safe end weld configuration. This configuration limits the volumetric examinations primarily to the wrought stainless steel safe-end side of this weld.

Manual volumetric examinations on the subject weld were conducted with procedures, personnel, and equipment that have successfully passed the performance demonstration requirements outlined in ASME Code Section XI, Appendix VIII. The techniques applied have been demonstrated for flaws located on the near-side of the welds. Far-side detection of flaws, as stated by the licensee, is considered to be a "best effort." No Appendix VIII requirements currently exist for demonstrating ultrasonic techniques through cast stainless steel. The licensee's ultrasonic scanning techniques included a combination of 45-degree shear, 0-degree longitudinal, and 60- and 70-degree refracted longitudinal waves (L-waves) for the subject Class 1 piping weld from the accessible wrought stainless steel side of the weld. L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds;[2, 3, 4] therefore, while the licensee has only taken credit for obtaining limited volumetric coverage, it is expected that the techniques employed may have provided coverage beyond the near-side of the welds. For ONS 1, the licensee implemented ASME Code Case N-663, "Alternative Requirements for Classes 1 and 2 Surface Examination"; therefore, no surface examinations were required for the subject RCP nozzle-to-safe end weld. This code case has been incorporated by reference into 10 CFR 50.55a by inclusion in RG 1.147, Revision 17, without any conditions. No recordable indications were noted during the performance of the volumetric examinations.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject weld due to the design geometry of the weld and materials of construction. Based on the volumetric coverage obtained, and considering the licensee's performance of ultrasonic techniques employed to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation was present in the wrought and welded portions of the ASME-required volume of the subject weld, evidence of it would have been detected by the examinations performed.

Therefore, the NRC staff concludes that the volumetric examinations performed to the extent possible provide a reasonable assurance of structural integrity and leak tightness

of the subject weld. Compliance with the ASME Code requirements for this weld would be a burden on the licensee.

3.5 RR No. 15-ON-002, Part E, Examination Category C-A, Item C1.30, Pressure Retaining Welds in Pressure Vessels, ONS 2

ASME Code Requirement: Table IWC-2500-1, Examination Category C-A, Item C1.30, requires essentially 100 percent volumetric examination, as defined by Figure IWC-2500-2 of the length of Class 2 tubesheet-to-shell welds. "Essentially 100 percent," as clarified by ASME Code Case N-460, is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 17.

Licensee's ASME Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations of the Steam Generator 2B upper tubesheet-to-shell Weld 2-SGB-W69.

Licensee's Basis for Relief Request: (as stated)

Steam Generator Tubesheet-to-Shell Weld (ONS2) - The impracticality was caused by four lateral restraints that did not allow scanning from the Surface 1, CW, and CCW direction, and only partial scanning from the Surface 2 direction, as well as the location of two lifting trunnions and a manway, which allowed only partial scanning from Surface 1. In order to scan all of the required volume for this weld, the lateral supports, lifting trunnions, and manway would have to be redesigned and replaced, which is impractical.

Licensee's Proposed Alternative Examination:

For this weld, the licensee reported the percentage of the examination coverage achieved by the UT in the examination performed.

The licensee proposed this alternative coverage (i.e., coverage achieved) for the volumetric examination of each weld in lieu of the ASME Code required essentially 100 percent coverage.

NRC Staff Evaluation:

The ASME Code requires essentially 100 percent volumetric examination of pressure retaining welds on selected Class 2 pressure vessels. However, for the subject steam generator tubesheet-to-shell weld, complete examinations are limited due to the proximity of surrounding appurtenances. In order to achieve greater volumetric coverage, the lateral supports, lifting trunnions, and manway would have to be redesigned or relocated. This would place a burden on the licensee; therefore, the ASME Code examinations are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittal, examinations of the carbon steel steam generator upper tubesheet-to-shell Weld 2-SGB-W69 have been performed to the extent practical, with the licensee

obtaining approximately 75.1 percent of the required ASME Code examination volume. The examinations were limited due to four lateral restraints, lifting trunnions, and manway. These appurtenances cover parts of the weld and adjacent base materials and restricted scans. The licensee manually examined these welds using 35-, 45-, and 60-degree shear waves to achieve partial circumferential and axial coverage along the weld length. No unacceptable indications were noted during the performance of the volumetric examinations.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject weld due to obstructions caused by the lateral supports, lifting trunnions, and manway. However, based on the volumetric coverage obtained, and the ultrasonic techniques employed, it is reasonable to conclude that if significant service-induced degradation was present in the subject weld, evidence of it would have been detected by the examinations performed. Therefore, the NRC staff finds that the coverage achieved is acceptable.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's submittals and concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RR Nos. 15-ON-002 and 15-ON-003. Furthermore, based on the volumetric examination coverage obtained, it is reasonable to conclude that if significant service-induced degradation was present, evidence of it would have been detected by the examinations that were performed. Therefore, the granting of relief is appropriate, pursuant to 10 CFR 50.55a(g)(6)(i), for the subject welds during the fourth ISI at ONS 1, 2, and 3.

As set forth above, the NRC staff has determined that it is impractical for the licensee to comply with the ASME Code requirement, that the proposed inspection provides reasonable assurance of structural integrity or leak tightness of the subject components, and that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest, giving due consideration to the burden upon the facility that could result if the requirements were imposed on the facility. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). Therefore, the NRC staff grants the RRs at ONS 1, 2, and 3 for the fourth ISI interval. All other ASME Code Section XI requirements for which relief was not specifically requested and granted remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: Joel Jenkins
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Date: July 22, 2016

If you have any questions, please contact the Senior Project Manager, Mr. James R. Hall, at Randy.Hall@nrc.gov or 301-415-4032.

Sincerely,

/RA/

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Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

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